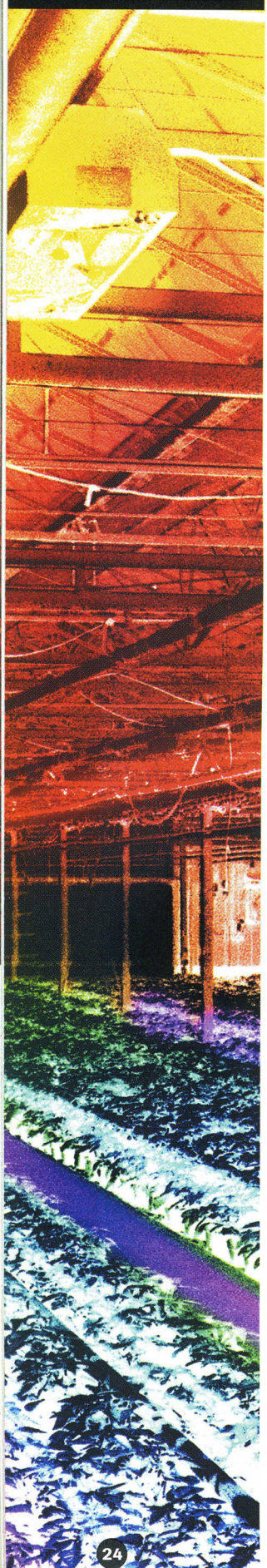

Infrared Heats Up

The second half of our two-part discussion of low-intensity, infrared radiant heating focuses on management and design of the system.

by ***JIM YOUNGSMAN***

INFRARED heating is a totally different concept of heating than what most growers expect. Those who are considering installing an infrared heating system in their greenhouses face many issues before they make their purchase. How do I control the system? Will my crops grow differently? Will the quality improve? Can I shorten the crop time? These are just a sampling of the questions growers have about infrared heating, which I will address in this article.

Planning Ahead

Growers should try an infrared heating greenhouse system in several greenhouses to determine the best installation. The best design allows the system to be hung high enough so the infrared pattern can span the desired width. Taller houses have the most versatility for effectively engineering a system.

Growers who install a CoRay Vac infrared heating system in a new greenhouse should match the system plan to the structure's configuration. The heating system is like the engine of a greenhouse, and it is best to design the greenhouse around the heating system.

Heating The Object

If heat rises, then why is an infrared heating system hung in the peak of the greenhouse? Heat is energy, and infrared energy is directed toward the object to be heated. While heated air in the presence of cold air rises, infrared energy does not convert to heat until absorbed by the object.

Knowing this principle, growers can understand infrared heating systems can be designed to efficiently heat the plants, soil, and any other objects in the greenhouse. Controlling plant temperature becomes easy and accurate because the device used to sense temperature receives the same infrared energy that the plants are receiving. Placing this sensor in an aspirated chamber will not work effectively because it is shielded from the infrared and senses only air temperature. With infrared heating, the air temperatures may be as much as 5°F to 7°F lower than needed in an air-heated house to maintain the desired plant and soil temperature.

Because gas-fired, low-intensity infrared heating systems warm plants evenly, naturally, and efficiently, all greenhouse crops will respond well. While it may take a change of thinking about how heating is accomplished, most growers adapt quickly to the advantages of growing with infrared heating. Some crops may even respond faster, and rooted cuttings or seedlings usually establish quicker because the soil is warmer. Quality is usually

Growers find that with the uniformity of infrared heat, multiple layers of hanging baskets, bench crops, and floor crops can be safely grown in the same greenhouse.

Infrared Radiant Heat

Hanging 16 feet above these 32-foot-wide beds, the infrared heating system has protected seedlings from frost when outside temperatures dipped to 14°F.

improved because the dryer leaf surfaces under infrared heat are more resistant to attack by airborne diseases, and some growers have found they can grow more plants in the same area with a slightly tighter spacing because of reduced disease. Growers also have discovered multiple layers of hanging baskets, bench crops, and floor crops can be grown in the same greenhouse because of disease reduction. The uniform heating expands the growing zone in the greenhouse because temperatures vary so little.

In addition, many infrared heating systems are designed to provide frost protection. There are acres of vegetable seedlings grown outdoors in California with only a CoRay Vac infrared system suspended 16 feet high over the beds for frost protection. One outdoor seedling grower reported protection when the temperature fell to 14°F. The system is most effective where night frosts are associated with relatively low wind.

Everyone Benefits

Growers who decide to install infrared heating fall into one of three categories: 1) those who decide their existing greenhouses are inefficient and expensive to heat; 2) growers who are building new greenhouses and, when nearly completed, decide infrared heating would be the best choice; and 3) growers who determine infrared heating is what they want and consult with a supplier about the most effective and efficient greenhouse design.

Growers in category No. 1 are fortunate if their existing greenhouses have tall sidewalls and gutters and a high peak. Tall, wide houses make it easier to design an effective infrared heating system. Growers with small, low quonsets or low, narrow-profile hous-

Infrared Radiant Heat

es will find it more difficult to design an economical system.

Growers who are building greenhouses commonly sold today (No. 2) are more likely to have adaptable structures. Today's construction trend is toward taller, wider houses with high sidewalls. Larger volume greenhouses provide a more manageable climate control. The popularity of growing hanging baskets and multi-level crops justify this trend.

Growers who are planning an integrated greenhouse system (No. 3) have the greatest flexibility in incorporating features into the finished product. This is important because it allows consideration for a design that can make best use of space, bench layout, aisle and traffic flow, and the least amount of area. In terms of cost per square foot of installation, growers can get the most bang for their buck in this scenario.

Design Considerations

There are several design factors growers should consider when installing a heating system. First, they should calculate the heat loss of their greenhouse. The total area of the structure's ends, sides, and roof is calculated, plus the perimeter distance of the greenhouse. That number is multiplied by a heat loss factor based on the difference between the lowest expected outside temperature and the desired crop temperature.

To illustrate the difference in the heat loss factor, the loss factor for an air-heated house will usually be 1.25, whereas the heat loss factor for an infrared-heated house will usually be 0.8. Using just the different heat loss factors, infrared-heated greenhouses show a conservative fuel savings of 36%. In addition, savings in electricity may be as much as 75% to 90%.

The reason for different heat factors is based on how effectively the heat is delivered. For example, a unit heater exhausts flue gases at as much as

How It Works

A CoRay Vac system is made up of as many as four burners intermittently spaced in four-inch diameter steel radiant tubing. At the exhaust end is a vacuum pump that pulls into each burner the proper mixture of air and natural gas or propane. The flue gases are then pulled through the system, heating the steel radiant tube to between 500°F and 800°F.

The vacuum pump discharges the spent flue gases consisting of carbon dioxide and water, at 150° to 200°F. The vacuum pumps are available in different sizes so it is possible to connect as many as four rows of burners to one pump.

It is also possible to design so each system can be treated as a separate temperature zone. The radiant tube is suspended below an aluminum reflector, which is shaped to direct the radiant energy evenly across the heated zone.

Infrared Radiant Heat

500°F, allowing a considerable amount of heat loss out of the flue. The air heating system heats air first, which in the presence of colder air rises to the top of a greenhouse. This creates a larger difference between inside air and the outside surface. To deliver heated air to the plants, it must be circulated. This air movement, while intended to mix the heated air above with the colder air below, washes a greater flow of heated air against the outside surfaces.

In addition, moving heated air across plants causes evaporation of moisture from plant surfaces, which cools the plants. To compensate, the air temperature must be several degrees warmer than the plants and soil to reach the desired plant temperature.

An infrared heating system does not depend on air movement to transfer heat energy to plants. Heat distribution with infrared heating is determined in the design of the system. Usually, growers can expect a well-designed system to provide uniform coverage to 95% of the area (±1°F). Corners and outside edges of a greenhouse offer a bit of a challenge with any heating system.

Another design consideration is the height of the installation. The ideal layout allows for sufficient hanging height. The infrared heating system should be suspended twice as high as the width of the area to be heated. In the widest greenhouses, two systems side by side should be suspended so each heats half the length of the house. Long greenhouses may require several systems along the length of the house.

Growers are often tempted to design their system for a low temperature rise if they are currently growing cool crops. It is advisable to design for this eventuality, so in the future warm crops may be grown. It is important that the capacity of heating be available to melt snow where that is a consideration.

If energy curtains are planned, they

A row of infrared heating units is suspended on each side of this retractable roof house. Bedding plants are growing on the floor and hanging baskets line the side aisles.

Infrared Radiant Heat

should be installed above the infrared system. Because greater fuel savings will come from the infrared heating system, adding heat-saving curtains may not provide enough additional savings to justify their costs. Curtains also cast shadows that may reduce light and growth of plants.

Retractable roof greenhouses are more difficult to heat because they have a single layer covering and have more air exchange. Infrared heating is ideal for these structures because the plants and soil are heated rather than the air.

For more than 25 years of use in greenhouses, gas fired infrared radiant heating has been used effectively with many types of greenhouse structures and every type of crop. High costs of fuel and energy will motivate growers to invest in efficient and dependable infrared heating systems.

Cost Conscious

If growers don't know now what it costs to heat their greenhouses, when the next round of energy cost increases occur, they'll likely be motivated to find out. There are several cases in which after a grower has retrofitted a greenhouse with a CoRay Vac infrared heating system, the gas company inspected the operation to determine why so much less fuel was being purchased. One grower in California was even accused of bypassing the meter.

Growers who desire energy savings and the need to produce better quality crops will take a hard look at heating their greenhouses with gas-fired, low-intensity infrared heating. They will likely find the savings in fuel and energy alone may pay for the installation in three to four years. **GG**

About the author: Jim Youngsman is the founder and former owner of Skagit Gardens, Mount Vernon, WA. He currently owns Growth Zone Systems LLC, a supplier of infrared heating systems.